U.S. DEPARTMENT OF COMMERCE
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PB80-110919

# Estech General Chemicals Corporation Duette Mine, Manatee County, Florida. Resource Document: Description of the Proposed Activity

Zellars-Williams, Inc., Lakeland, FL

Prepared for

Environmental Protection Agency, Atlanta, GA. Region IV

Oct 79

PB80-110919

United States
Environmental Protection
Agency

Region 4
345 Courtland Street, NE
Atlanta, GA 30308

EPA 904/9-79-044I
October 1979

EPA

# Environmental Impact Statement

DRAFT

## Estech General Chemicals Corporation
## Duette Mine
## Manatee County, Florida

DESCRIPTION OF THE PROPOSED ACTIVITY

# RESOURCE DOCUMENT

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U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

| BIBLIOGRAPHIC DATA SHEET | 1. Report No. EPA 904/9-79-044I | 2. | 3. Recipient's Accession No. PB80-110919 |
|---|---|---|---|
| 4. Title and Subtitle<br>Draft EIS Estech General Chemicals Corporation Duette Mine; Manatee County, Florida Volume I, Description of the Proposed Activity Resource Document | | | 5. Report Date<br>October 1979<br>6. |
| 7. Author(s)<br>EIS Branch, EIS Preparation Section | | | 8. Performing Organization Rept. No. |
| 9. Performing Organization Name and Address<br>Zellars-Williams Inc.<br>4222 South Florida Ave.<br>Lakeland, FL 33803 | | | 10. Project/Task/Work Unit No.<br>11. Contract/Grant No. |
| 12. Sponsoring Organization Name and Address<br>EIS Branch, U.S. EPA<br>345 Courtland St.<br>Atlanta, GA 30308 | | | 13. Type of Report & Period Covered<br>Draft<br>14. |

15. Supplementary Notes

16. Abstracts

The Draft Environmental Impact Statement for the Estech General Chemicals (formerly Swift Agricultural Chemical) Duette Mine is enclosed for your review and comment. The document has been prepared pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA) (Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. Thirteen volumes of resource document were also prepared. These resource documents comprise the detailed technical evaluations of the alternatives and the proposed action and contain supporting data related to the Draft EIS. While the Draft EIS is a complete document.

17. Key Words and Document Analysis. 17a. Descriptors

Volume I
Description of the Proposed
Activity
Duette Mine

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

| 18. Availability Statement | 19. Security Class (This Report) UNCLASSIFIED | 21. No. of Pages 45 |
|---|---|---|
| | 20. Security Class (This Page) UNCLASSIFIED | 22. Price A03-A01 |

# DESCRIPTION OF THE PROPOSED ACTIVITY

## RESOURCE DOCUMENT

## Draft Environmental Impact Statement

Swift Agricultural Chemicals Corporation
Duette Mine Site
Manatee County, Florida

October, 1979

Prepared For: U. S. Environmental Protection Agency
Region IV
345 Courtland Street. N.E.
Atlanta, Georgia 30308

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DESCRIPTION OF THE PROPOSED ACTIVITY
RESOURCE DOCUMENT

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NOTE:

Effective August 1, 1979, Swift Agricultural Chemicals Corporation changed its name to Estech General Chemicals Corporation.

The preparation of the Draft Environmental Impact Statement was substantially completed at the time of the name change. Therefore, the name of Swift Agricultural Chemicals Corporation (Swift) is used throughout the Draft Environmental Impact Statement and all attendant Resource Documents.

# DESCRIPTION OF THE PROPOSED ACTIVITY

## 1. INTRODUCTION

Swift Agricultural Chemicals Corporation proposes to use equipment and design generally available and practiced by the presently operating mines. The components of the operation, as shown on Figure 1-1, are two large walking draglines for parallel ore extraction from two mines; hydraulic ore transportation via pipeline to a central washer for ore disaggregation and pebble recovery; a feed preparation and flotation plant for extraction of finer phosphates; wet rock storage and drying; and shipment via rail. Clay and sand wastes are to be disposed of initially in separate areas, but will subsequently be mixed into a common backfill using the method that proves to be most viable technologically and economically.

## 2. MINING OPERATION

### 2.1 Earth Moving

Swift proposes to use two draglines for earthmoving in their mining process. The draglines have 58 cubic yard buckets, capable of a 50,000 cubic yard per day production capacity. Dragline size is dictated by the total earthmoving requirement to sustain a production rate of 3 million short tons of product annually.

Each dragline mines by digging parallel cuts approximately 300 feet wide and up to one mile in length. The draglines strip the overburden from atop the matrix and deposit this "spoil" in the previously mined

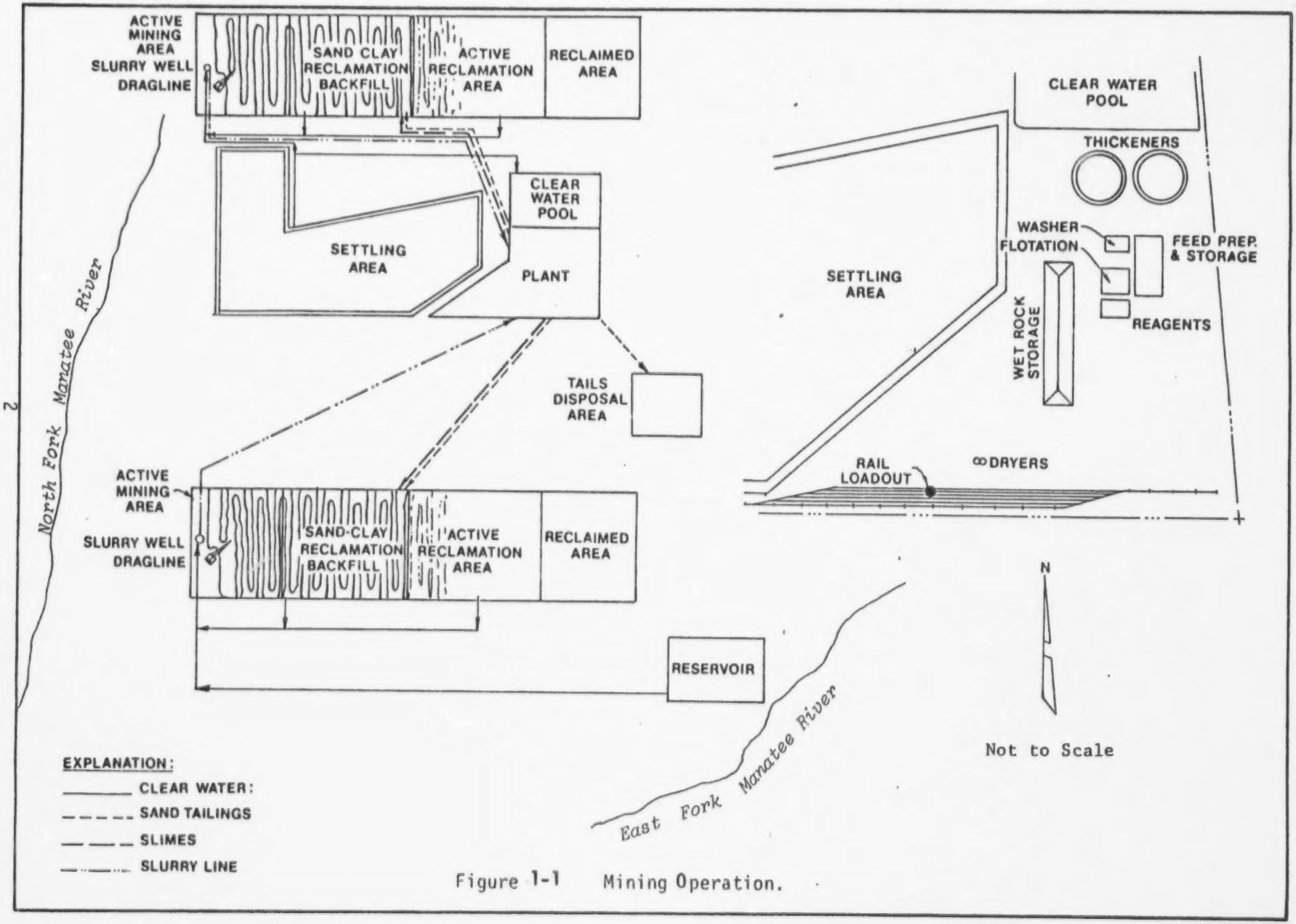



Figure 1-1 Mining Operation.

out cut. When sufficient matrix has been exposed, it will be excavated and dumped into a slurry pit or "well" -- an excavated sump within reach of the dragline. These slurry pits are constructed along the line of dragline advance. A pit control car sits adjacent to the slurry pit, directing high pressure water guns at the matrix and breaking it into a slurry.

### 2.2 Ore Transportation

Separate pumping systems for each dragline deliver the slurrified matrix to the plant. Each pumping system has a "pit pump", the suction of which draws the matrix slurry in the "well" into a pipeline. With the aid of booster or lift pumps the pipeline transports the matrix slurry at the velocity necessary to maintain solids suspension. The first lift pump is generally located within 1500 feet of the pit pump, with additional lift pumps spaced at appropriate intervals throughout the pumping system. The number of lift pumps required in a system depends on pumping distance and the head developed by each pump.

## 3. PROCESS DESCRIPTION

### 3.1 Washer Operation

When the slurrified matrix arrives at the washer the following steps are taken: 1) separation and rejection of the plus 3/4 inch material (roots, lime cobbles, mud balls), 2) disaggregation of the clays in the matrix, 3) washing and separation of the pebble material in the matrix including saving, rejecting, or upgrading as

indicated by visual inspection and pebble analysis, and 4) delivering the feed and clay underflow to the feed preparation area.

Waste Pebble - The sedimentary marine deposits that make up the phosphate matrix contain a "pebble" product, ranging in size from +1mm upward. A percentage of the Swift matrix is made up of pebble, but not all of this material is high enough in phosphate content to qualify as a salable product. That material not having an acceptable BPL content is discarded as waste.

Pebble Product - The "pebble" material in the matrix having an acceptable BPL content is regarded as pebble product. Pebble cleaning is achieved by alternately sizing with vibrating screens and attritioning with log washers. Product is stored in pebble bins for dewatering and quality control analysis prior to shipment or placement on wet rock storage piles.

3.2 Feed Preparation

The primary activities conducted in the feed preparation area are: 1) separation by hydrocyclone of the flotation feed size fraction (14 x 150 mesh) from the minus 150 mesh clays and fine grain size minerals, 2) provision for feed surge and storage capacity, 3) sizing of plus 20 mesh particles from the flotation feed (this material is to be processed separately to improve recovers), 4) attrition scrubbing of the flotation plant feed as necessary to

improve recovery and reduce reagent use, and 5) delivery of feed to the flotation plant at a uniform rate.

### 3.3 Flotation

Flotation incorporates the two-stage process, consisting of a "rougher" flotation or separation of the phosphate particles from the silica sand by the use of the fatty acid reagent suite, followed by de-oiling and "cleaner" flotation by an amine flotation of the sand particles. Typical reagent consumption per short ton of product is as follows:

| Rougher Reagents | Approximate Application Per Ton of Product |
|---|---|
| No. 5 Fuel Oil | 8.0 pounds |
| Caustic | 0.8 pounds |
| Tall Oil | 4.0 pounds |
| Sulfuric Acid | 4.0 pounds |
| **Amine Reagents** | |
| Amine | 0.4 pounds |
| Kerosene | 0.3 pounds |

Final concentrate is dewatered and the water is recycled to the flotation plant. The concentrate is then transferred to wet rock storage. The waste sand tailings are removed from the plant by slurry pumping.

## 4. PRODUCT DISPOSITION

### 4.1 Wet Rock Storage

Wet phosphate rock is received from the concentrate and pebble dewatering bins at about 16% moisture and stored in open piles.

Sufficient storage space is provided to allow for separation of concentrate and pebble "rock" products by grade and/or contaminant content. Storage is necessary to facilitate blending or rock, to meet shipment specifications, and to maintain inventory. Dewatering of rock to about 13% moisture occurs while in storage, with drainage contained and directed to the plant water system. The wet rock reclaim system is capable of delivering wet rock to either the dryer feed bins or the wet rock loadout bins. The main rail loadout system is designed for dry rock shipping (Figure 4.1-1).

## 4.2 Drying

In the proposed design, a final step in the processing cycle is rock drying (Figure 4.1-1), but there is also provision for rail shipment of wet rock to satisfy customer commitments. Wet rock from the storage piles is reclaimed according to the blend of pebble and concentrate required to yield desired chemical and physical properties, and may either be delivered to a wet rock rail car loading station or to the rock drying, storage, and railcar loading facilities.

Wet rock is supplied from feed bins to two fluidized bed rock dryers, and moisture is removed by passing heated air upward through the bed of rock at a sufficient velocity to support the rock particles and expand (fluidize) the bed. The heat is supplied by combustion of low sulfur No. 6 residual fuel oil. Dried rock is discharged from the drying systems to a dry product conveyor for delivery to the dry rock storage silos.

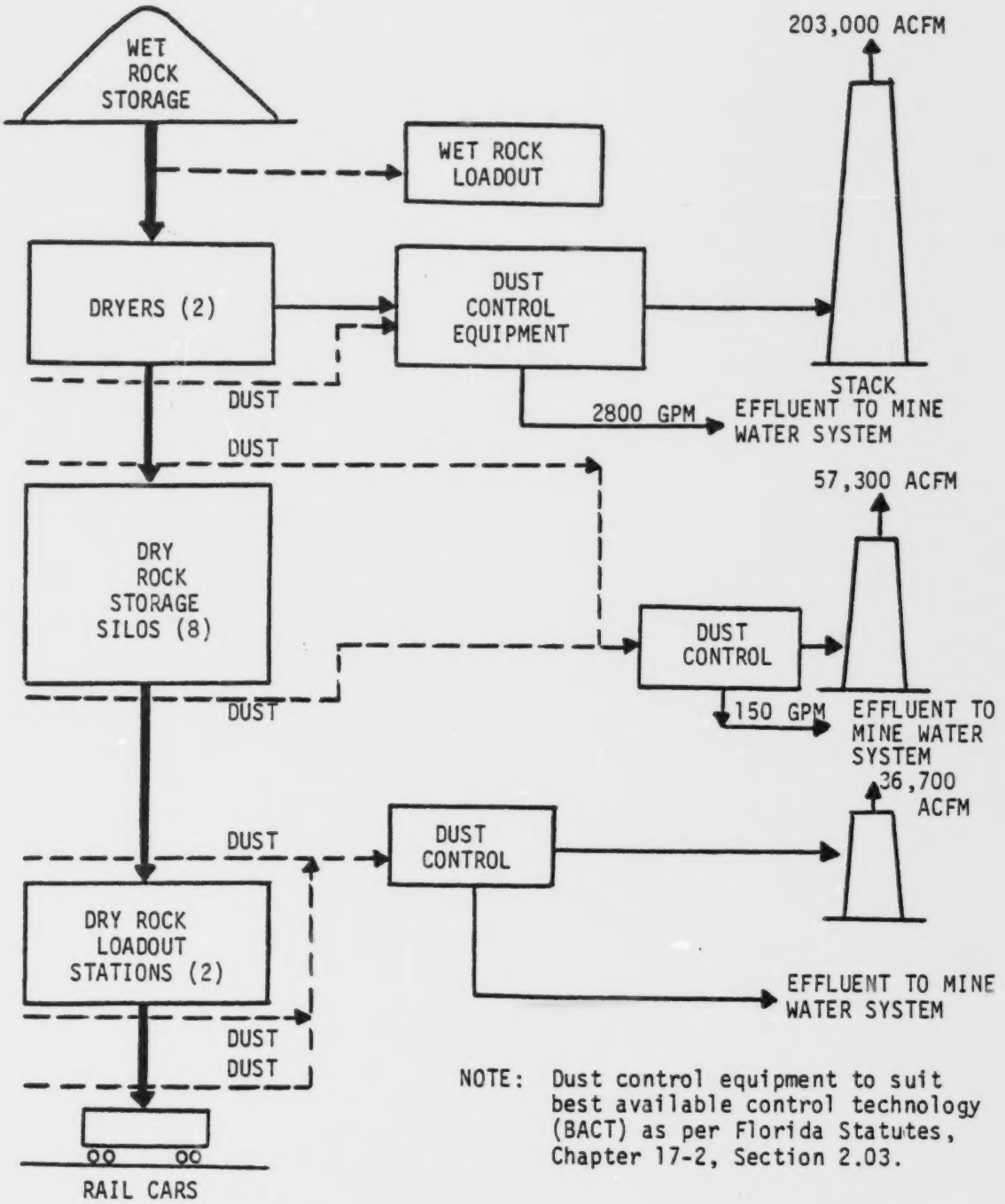



Figure 4.1-1 Product Disposition Simplified Flowsheet.

It is proposed that pollutants generated by the combustion of fuel oil and dusts generated by drying and handling the phosphate rock product will be controlled using wet scrubbing technology. Water used for scrubbing will be recycled to the mine water system.

Equipment Description - The rock drying facility consists of two fluidized bed rock drying systems with a production capacity of 1.95 million tons per year of dry rock each. Each system is designed to dry rock from 13 to 2 percent moisture at a rate of 262 tons per hour.

Wet rock is supplied to the fluidized-bed rock from each of two 1,000 ton capacity feed bins. No. 6 residual fuel oil containing no greater than 1 percent sulfur will be supplied to the dryer combustion chambers from an 80,000 gallon storage tank.

Fluidization may be defined as the suspension and agitation of a bed of particulate solids by a vertically rising stream of gas. Since each particle is surrounded by the gas, heat transfer is rapid and moisture removal is more efficient than is possible with available alternatives. The word "fluid", as used here, means that fluidized solids exhibit many properties of a liquid.

The fluidizing gas is preheated to about 1,800°F in the combusion chamber by combustion of the fuel oil. A fluidizing blower delivers air at sufficient pressure to achieve fluidization. A distributor plate in the dryer supports the rock and uniformly distributes the hot gas across the cross-section of the dryer. Bed temperature immediately

above the distributor plate is typically maintained at about 230°F and most of the product exits the dryer to a dry product conveyor at this temperature. Some carry-over of finer particles and dusts occur in a fluid-bed system, but the gas velocity is maintained at a rate so that carry-over is not excessive. Fine particles and dusts that do carry over in the dryer exit gases are next routed through product recovery cyclones to remove all economically recoverable product form the gas stream. The recovered product is also discharged to the dry product conveyor for delivery to the dry rock storage silos.

The dryer systems will be served by three wet scrubbing systems. Two venturi absorbers will serve the recovery cyclone exit gas streams and these units are designed to achieve efficient removals of both particulate matter and sulfur dioxide gas. The absorption phase of the system is also expected to achieve some removal of other pollutant gases produced in the drying process, e.g., nitrogen oxides, trace fluoride gases, etc., but accurate estimates cannot be projected at this time. A separate fugitive dust control scrubber is included to serve dust collection systems at points where the dryers and recovery cyclones discharge to the dry product conveyor. Liquid effluent discharged from the scrubbing systems will be primarily a water slurry containing fine phosphate and clay particles and insoluble sulfite/ sulfate salts. The slurry will be pumped to clay settling areas for recovery and reuse of the process water component.

## 4.3 Dry Rock Storage and Shipping

Dryer product is transferred to storage silos by the dry product conveyor and the material is stored for relatively short periods of time until a sufficient supply of rail cars are obtained to complete a shipment (Figure 4.1-1). The dry rock is then transferred from the silos to the loadout facilities and loaded into rail cars on an essentially two shift basis. The conveyors used to transfer the product are enclosed to prevent dust emission, and all transfer points are provided with fugitive dust collection systems which lead to the wet scrubbing control equipment. Liquid effluent from wet scrubbers will be discharged to the mine water system.

Equipment Description - The dried rock is transported on an enclosed 600 tons per hour dry rock conveyor to a system of chutes and enclosed conveyors designed to load any one of eight concrete storage silos of 3,750 tons live load each. All points of fugitive dust emission are served by a system of dust collection hoods and ducts leading to a wet scrubber designed to efficiently remove dust from the collection system gas stream.

The silos are arranged in two rows (of four silos) centered over enclosed dry product loadout conveyors of 1,200 tons per hour capacity each. The loadout conveyors deliver dry product to 100 ton loadout bins located at each of the two railroad car loading stations. The loadout bins are mounted on electronic load cells for precise determination of shipping weights. All points of fugitive dust emission at active silo discharge locations and at points of bin loading will be served by

collection systems and wet scrubbers to efficiently remove dust from the dust collection system gas streams.

The loadout bins will discharge to railroad hopper cars through specially designed fugitive dust control spouts. The spouts seal the railroad car hatches and exhaust air into a collection system which is served by another wet scrubber. The loadout facilities are designed to load a minimum of 6 cars per hour per station and to operate a maximum of 16 hours per day.

Liquid effluent from the scrubbing systems will contain fine phosphate and clay particles. The effluent will be pumped to clay settling areas for recovery and reuse of the water component.

# 5. WASTE DISPOSAL

## 5.1 Description of Wastes

In addition to phosphate rock product, the beneficiation of the phosphate ore discussed in Section 1.2.3 will generate two solid waste products: (1) clay or "slimes" consisting of -150 mesh material and (2) sand tailings consisting of -14+150 mesh material. The clay wastes consist primarily of silicate clay minerals, very fine apatite (rock phosphate), and other minerals such as feldspar and dolomite. The sand tailings consist primarily of quartz particles but contain some apatite as well.

## 5.2 Disposal Methods

Traditionally the two waste materials have been transported to separate disposal areas. The clays have been impounded behind earthen dams constructed around natural ground or mined-out areas. The sand tailings have been disposed of in mined-out pits or in some cases in aboveground piles. Recent experimental work has been conducted on using a mixture of the two wastes to backfill mine cuts. Because this waste disposal technique has the potential of reducing the need for conventional aboveground clay disposal areas, enhancing water recovery efficiency, and providing reclaimed land with a broader land use potential at an earlier date, the Duette operation has incorporated this concept into its waste disposal plan.

Sand-Clay Mixture - Early attempts to achieve a mixture of sand and clay in waste disposal areas have been hindered by the differential settling rates of the sand and clay particles. Recent research has shown that the following two techniques have promise for overcoming this problem and achieving a more homogeneous mixture.

(1) Intermittent spraying of sand tailings in aqueous suspension over previously thickened clays with periods of settling and mixture.

(2) Simultaneous introduction into mine cuts of sand tailings in aqueous suspension and clays treated with chemical flocculants to enhance their settling rate.

Swift has not yet elected the mixture method to be used in its sand-clay waste disposal program. Research in this area continues and technological advances can be expected in coming years. At the time the mine becomes operational, Swift will select a method based on the economic and technological feasibility of the choices available.

The method chosen will mix the sand and clay in the approximate ratio of 2.5 to 1 (by weight). The mixture will be introduced into waste disposal areas enclosed by levees averaging 14 feet in height. The enclosed areas will be filled to an average height of nine feet above natural grade, thereby leaving a freeboard of five feet to the top of the levee. Filling aboveground is necessary to allow for subsidence of the material as it dewaters and consolidates, and to facilitate gravity flow within the water return system.

The size of each area will be determined by the required retention area and time for water clarification, and the production rate of waste materials. Approximately 5,426 acres are planned for use as sand-clay-type disposal, all but 200 acres of which will be in mined-out areas.

Clay Wastes - A single 480-acre conventional clay settling area is planned for the Duette mine. Most of this area will be constructed on natural ground and will receive all the clay wastes generated before the sand-clay mix procedure becomes operational. The settling area will remain active throughout the life of the mine to receive any clay wastes in excess of the sand-clay mix requirements and to serve as a secondary or supplemental water clarification and storage area. Clay slurries will be transported to this area by gravity flow in open ditches and then pumped over the dike into the area. By the end of the mine life, the area will have been filled with clays to an average of approximately 25 feet above natural grade.

Sand Tailings Wastes - On the average, the Duette ore contains sand wastes slightly in excess of the amounts required in the sand-clay mix process. These excess sand wastes will be transported hydraulically to mined-out areas and deposited in the mining cuts. The level of filling will be determined by drainage requirements and the amount of overburden available in the protruding spoil piles to cover the sand tailings fill. In general, sand tailings landfills will extend several feet above natural grade; in every case, the level of filling will

leave sufficient overburden material exposed to provide for an overburden cap averaging two feet in depth. Tailings landfills will for the most part be placed along the watershed divide between the East and North Forks Manatee River.

In the first year of mining, sand tailings are planned to be used in the construction of retaining dikes. Thereafter, an average of 42 acres per year will be backfilled with tailings for a total of 848 acres over the life of the mine.

# 6. WATER MANAGEMENT SYSTEM

## 6.1 Water Use Plan

Water is used in ore transportation, washing, preparation of feed, flotation, and waste disposal operations. Specific water use needs are categorized as:

- "Sluicing water" for slurrying phosphate ore at the mine and transporting it to the washer.
- "Seal water" for large centrifugal pumps.
- "Washing/dilution water" for ore disaggregation.
- "Rinsing water" for reagent removal and the cleaning of flotation feed.
- "Process water" for rougher and amine flotation.
- Water for other miscellaneous process uses.

The majority of these operational requirements will be supplied by water from the recirculation system. Water will be recycled, though losses occur from entrainment in waste or products, or from seepage into impounding embankments. The recirculation system water supply capacity will be relatively small during startup and the early years of operation, requiring ground or makeup water at more variable rates until the surface water reservoir and clay impoundment reservoirs are developed. The impoundment areas, ditches, seepage collection facilities and water return system are to be engineered to account for water losses due to discharge, evaporation, etc.

Figure 6.1-1 depicts mining and processing operations as they are planned after the third year, when the surface water reservoir is to be operational, and a mined out area available for land reclamation.

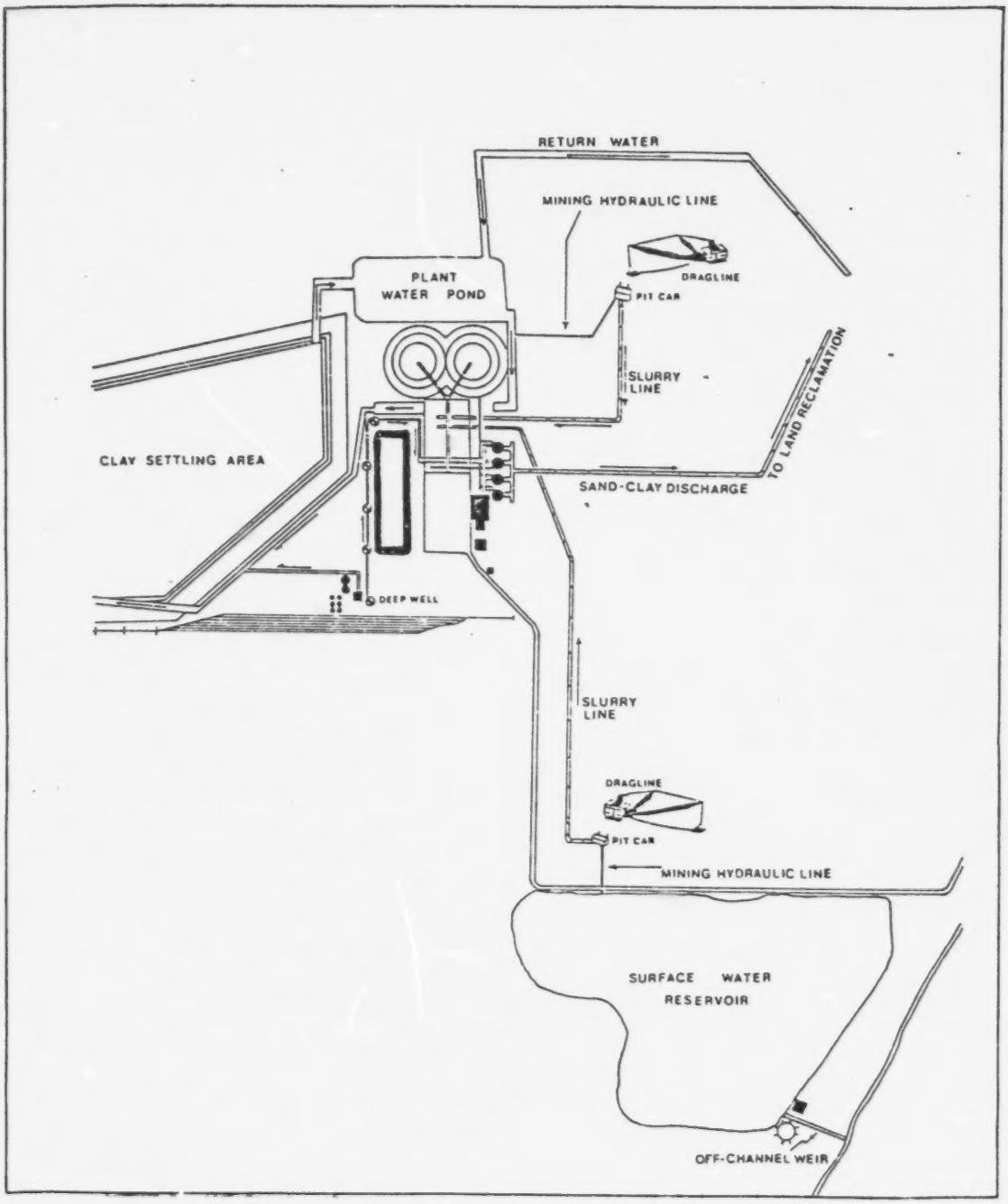



Figure 6.1-1 Water Use Plan.

Water for one of the mining areas will be partially supplied by the the surface water reservoir; it will be used to slurrify the matrix for transportation by pipeline to the washer. The other mining area will use water from the recirculating system. At the washer in the plant area (see Figure 6.1-1 ) the majority of the clay is removed and pumped to a desliming cyclone located at feed storage. The slimes are then pumped to a thickening device where they are mixed with sand tailings pumped from the flotation plant. At this point a water release is effected, and water is immediately returned to the plant pond for reuse. The thickened sand-clay mixture is pumped to a mined out area for land reclamation. Water which decants from the mixture as it is placed in below ground areas is pumped back to the clay settling area for final clarification before reuse in the plant water system. Secondary slimes from the feed preparation and flotation plants are treated in two 400 foot clarifiers which thicken the clay and overflow clarified water to the plant water pond for "rapid" recycle to the process. The sand-clay mixture used for land reclamation may reduce the amount of water entrained in the clay (i.e., the final percent solids of the clay is higher than conventional settling). This would release more water for reuse by the plant. Correspondingly, the volume of clay waste is reduced, thereby reducing the need for above-ground clay storage areas.

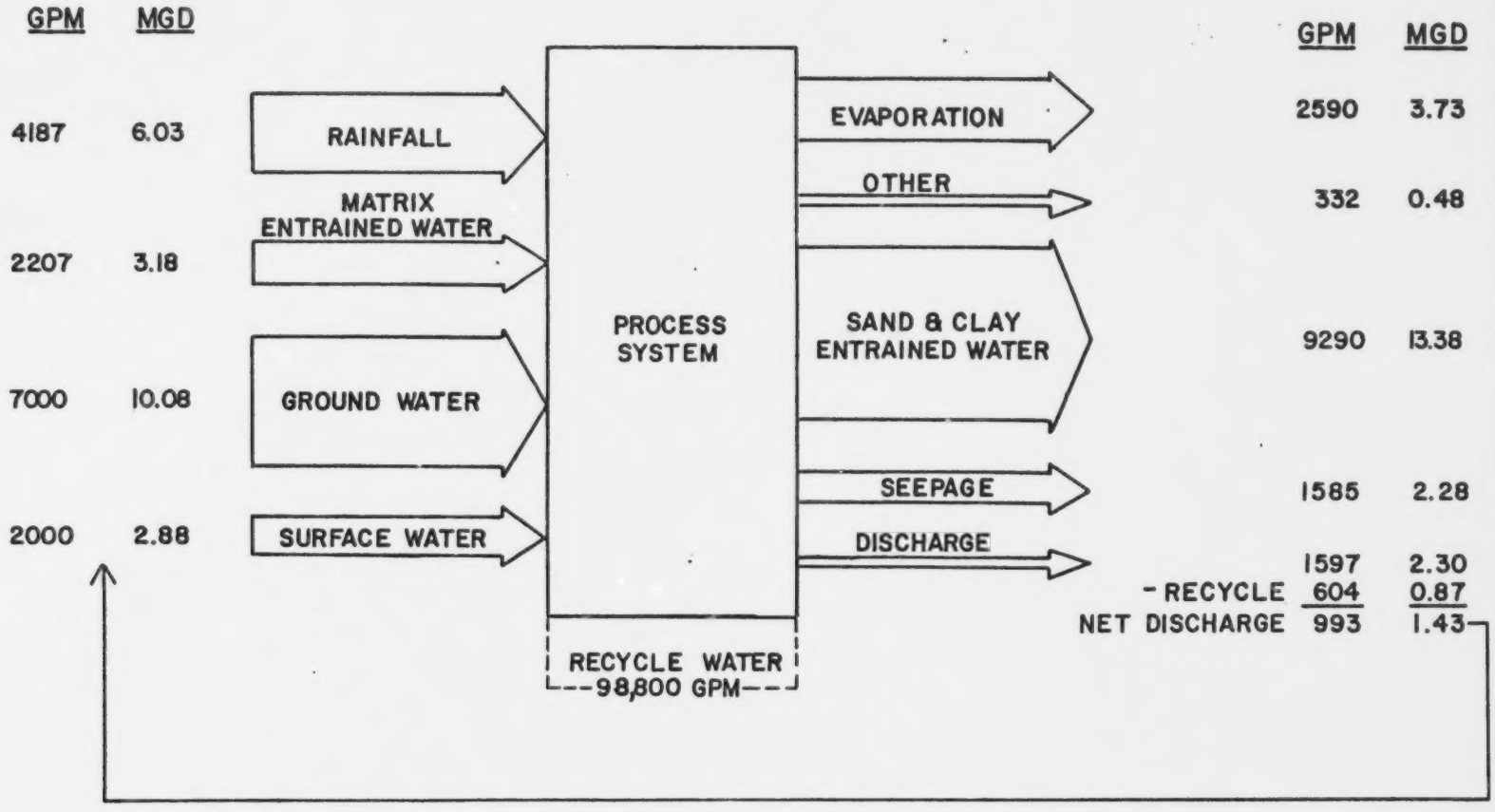
There will be some sand which is not mixed with clay but pumped directly to the land reclamation site. Water used in this pumping will also be returned to the mine recirculation system for reuse.

## 6.2 Recirculation

The water balance established for the system is shown on figure 6.2-1. Losses to the system, shown on the right of the diagram, are primarily attributable to water entrained in sand and clay waste backfilling. The makeup water required for these losses totals an average 11,207 gpm (16,138,000 gpd). Sources of supply are shown on the left. Water within the ore accounts for 2,207 gpm. The remainder is to be supplied by groundwater pumpage until the fourth year, when surface water diversion from the East Fork Manatee River will supply an average 2,000 gpm to the total makeup requirements, leaving 7,000 gpm to be supplied by groundwater. The total water system requirement is 98,800 gpm of which 89 percent is recycled and two percent is supplied by ore moisture, leaving nine percent to be supplied by makeup sources.

## 6.3 Rainfall Catchment - Discharge

The water balance in section 6.2 is the disposition of the mine recirculating system in response to identifiable losses or sources. The water balance is based on average annual data and does not reflect variations in losses or gains that may occur seasonably. The recirculating system is imposed on the regional and onsite drainage systems. It is also responsive to variations in water input and losses as a result of meteorologic phenomena including variable rates of rainfall, runoff, and evaporation. Figure 6.3-1 illustrates the relationship of the system to climatology and drainage.




GPM - gallons per minute
MGD - million gallons per day

FIGURE 6.2-1 Process water balance

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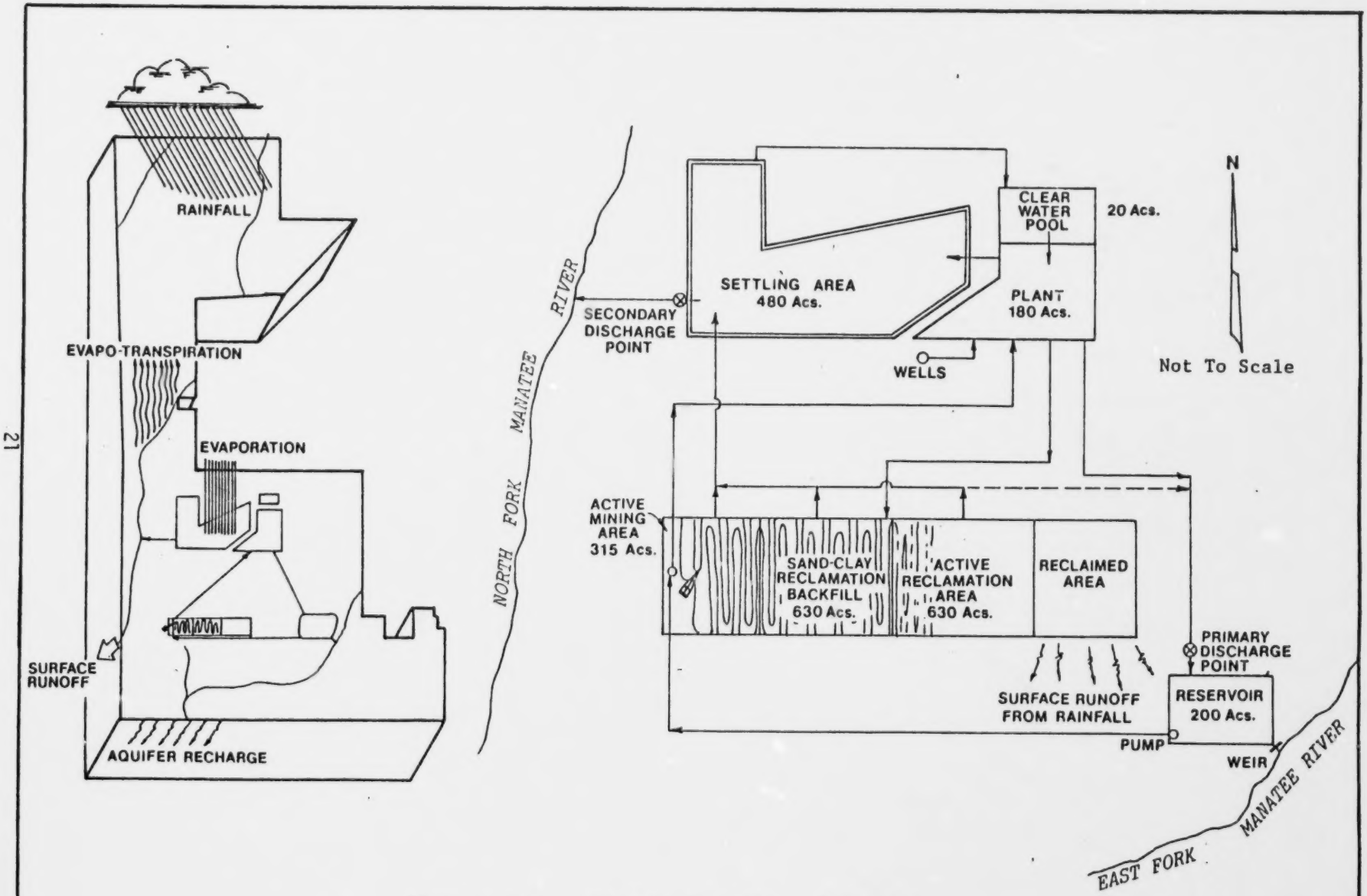


Figure 6.3-1 Rainfall Catchment - Discharge.

During most of the mine life, about 2,465 acres out of the total 10,394 acres is actually involved in mining, waste disposal, or reclamation function, broken down as follows:

| | | |
|---|---|---|
| a) | Clear water pool | 20 acres |
| b) | Clay settling pond | 480 acres |
| c) | Surface water reservoir | 200 acres |
| d) | Active waste disposal area | 630 acres |
| e) | Active mining area | 315 acres |
| f) | Plant site | 180 acres |
| g) | Areas under reclamation | 630 acres |
| h) | Ditches | 10 acres |
| | Total | 2,465 acres |

All of these areas collect rainfall and retain it from natural runoff by being a natural catchment. None of this water is to be released to the natural drainage system without monitoring for quality. Areas a, b, c, and some portion of d are all water surfaces exposed to evaporation losses, which exceed rainfall catchment by an estimated 10 inches annually, but vary seasonally depending on humidity, temperature, wind velocity, etc. Runoff will be encouraged on a majority of the remaining areas so that reclamation consolidation and mine recovery can proceed. This means the rainfall will be drained into other water storage areas, if available. Within the drained areas the runoff is considerably in excess of evaporation and/or transpiration losses. Thus the mine water balance is seasonally "imbalanced" by climatic variability in the amount of water falling within or evaporated from

the catchment area. Good management practice would call for maximum utilization of available water storage volume (areas a, b, c) to store water during events or seasons of high rainfall and/or low ET losses for use during drier or high ET loss periods. It should also be noted that the period of high rainfall incidence and storage availability coincides with the period of most planned diversion of surface water from East Fork Manatee River into the 200 acre surface water reservoir.

In an "average" climatological year, the collection capacity will surpass storage capacity, thus necessitating periodic discharge to maintain safe operating fluid levels. It is assumed in this case that discharge into the East Fork will be the primary point, to be supplemented by periodic discharge from the 480 acre settling pond. Other discharge points or preferential rates may change during mine life, and require permitting and operational revisions. It is important to emphasize that the water balance, mine water system, and recirculation system are based on average ore characteristics, production rates, and climatology, all of which are likely to be annually variable.

## 7. RECLAMATION METHODOLOGY

### 7.1 Physical Restoration

With the exception of a single 100-acre area designated for natural restoration, all land disturbed by the operation will be restructured and/or backfilled with waste materials in conformance with county and state slope requirements. In sand-clay mix landfills, the exterior levees and any protruding spoil piles will be graded down. Beyond conforming to slope requirements, no attempt is planned to cap sand-clay landfills.

In the clay settling area, the formation of a dry surface crust will be encouraged by the installation of perimeter and interior ditches to induce drainage. When the crust has formed, the retaining dike will be pushed down and any volunteer vegetation cleared from the area.

In sand tailings landfill areas, the overburden material in the protruding spoils will be distributed over the landfill to an average depth of two feet.

In land and lake areas, the spoils will be graded to conform with terrestial slope requirements and to form littoral zones consisting of 12 to 1 subaqueous slopes out to a depth of 6 feet.

In disturbed natural ground areas, all facilities will be dismantled when mining is complete and the areas graded as necessary to conform to slope requirements.

In addition to these primary physical restoration techniques, several special techniques are planned to serve particular reclamation goals. A three-quarter mile segment of the East Fork Manatee River is to be restored by creation of a floodplain and channel with the same elevation and gradient as the existing stream. This physical restoration effort includes the placing of obstructions in the reclaimed channel to encourage the stream to meander.

Shallow basins allowed to form around the drainage outlets in sand-clay landfills will be retained as marsh environments. Drainage swales will be constructed through adjacent sand-clay landfills to interconnect these marshes.

A 100-acre land and lake area has been designated as a natural restoration area. The only reclamation efforts in this area are to be the topping of spoils to eliminate peaks and the interconnection of water bodies to provide a flow-through system at high water stages.

## 7.2 Revegetation

Forage Crop Planting - Revegetation plans call for approximately 6,000 acres of reclaimed land to be planted in forage grasses and legumes. Forage species will be selected to match the potential productivity of each reclaimed soil type. All forage plantings will include legumes in order to supply nitrogen to the pasture sods.

Reforestation Plantings - Reforestation plantings planned for the site will be of two general types - upland and wetland area plantings. In upland areas, mixed plantings of native species such as water oak, live oak, longleaf pine, slash pine, etc. will be made in strands approximately 150 feet x 1,000 feet. Plantings will include both seedlings and trees of 2"-4" diameter transplanted from on-site areas with a tree spade. Two strands with a planting density of 60 trees per acre are planned for each section of reclaimed pasture land.

Clusters of eucalyptus plantings are also planned for upland pasture areas. These plantings are intended to provide cattle shade while the slower growing native trees are becoming established. They may be harvested for pulpwood when they are no longer needed for this purpose.

Wetland reforestation efforts will be carried out in the restored segment of the East Fork Manatee River and along several major drainage swales interconnecting marshes in sand-clay landfills. In the restoration of the 55-acre segment of the East Fork Manatee River, the soil will first be stabilized by forage plantings. Then native trees of 2"-4" diameter will be transplanted from the existing floodplain at a density of 60 trees per acre. The transplanted trees will have 2-3 years to establish themselves before the stream is diverted into the new channel.

Reforestation of four major drainage swales totalling 430 acres is planned by transplanting potted and bare-root seedlings at a density of 100 trees per acre. Only native hydric trees will be used in the plantings.

Natural Revegetation - Two types of reclaimed land will be allowed to revegetate naturally. The shallow basins created in sand-clay landfills are expected to be favorable environments to develop marsh-type vegetation naturally. Such has occurred in hydric environments in present mining areas. In view of this observation and the present lack of technology or species preference in the field of induced wetland revegetation, no planting efforts have been planned.

The second type of area to be allowed to revegetate naturally is a 100-acre land and lake area in the northwest portion of the tract. This area is bordered on the southwest by an undisturbed segment of the South Fork Little Manatee River. The native vegetation in this tributary is presumed a seed source for the natural revegetation of the mined area to the northeast. The site is intended to serve as an area of limited accessibility to man where wildlife can live and find refuge.

## 7.3 Reclamation Chronology

The various types of physical and revegetative reclamation will require different time periods to complete. Contouring and revegetation of land and lake areas is estimated to require two years to complete. Backfilling with sand tailings, capping with overburden, and revegetating will require about three years. Landfills that involve clay will require longer periods because of the subsidence that will occur as the clays dewater. In sand-clay landfills, two years has been allotted to filling, two years to subsidence and consolidation, and an additional year to revegetation, for a total of five years to complete reclamation. Because of the lengthy period required to form a surface crust, ten years has been allotted to complete reclamation of the single clay settling area. Table 7.3-A summarizes the reclamation schedule.

## TABLE 7.3-A
## ANNUAL RECLAMATION SCHEDULE

| Year | Disturbance | Sand-Clay Landfill | Tailings Landfill | Clay Settling Area | Plant Site | Land and Lake Areas | Natural Restoration Area | Cumulative Total |
|---|---|---|---|---|---|---|---|---|
| Pre-Mining | 690 | | | | | | | |
| 1 | 303 | | | | | | | |
| 2 | 439 | | | | | | | |
| 3 | 303 | | | | | 224 | | 224 |
| 4 | 357 | | 42.4 | | | | | 266.4 |
| 5 | 379 | | 42.4 | | | | | 308.8 |
| 6 | 338 | 100 | 42.4 | | | | | 451.2 |
| 7 | 361 | 393.6 | 42.4 | | | | | 887.2 |
| 8 | 363 | 257.6 | 42.4 | | | | | 1187.2 |
| 9 | 295 | 310.6 | 42.4 | | | | | 1540.2 |
| 10 | 327 | 333.6 | 42.4 | | | | | 1916.2 |
| 11 | 281 | 292.6 | 42.4 | | | | | 2251.2 |
| 12 | 222 | 315.6 | 42.4 | | | | | 2609.2 |
| 13 | 358 | 316.6 | 42.4 | | | | | 2968.2 |
| 14 | 275 | 249.6 | 42.4 | | | | | 3260.2 |
| 15 | 377 | 281.6 | 42.4 | | | | | 3584.2 |
| 16 | 340 | 235.6 | 42.4 | | | | | 3862.2 |
| 17 | 322 | 175.6 | 42.4 | | | | | 4080.2 |
| 18 | 293 | 312.6 | 42.4 | | | | | 4435.2 |
| 19 | 315 | 229.6 | 42.4 | | | | | 4707.2 |
| 20 | 346 | 331.6 | 42.4 | | | | 100 | 5181.2 |
| 21 | 299 | 293.6 | 42.4 | | | | | 5517.2 |
| 22 | | 276.6 | 42.4 | | | 100 | | 5936.2 |
| 23 | | 247.6 | 42.4 | | | 150 | | 6376.2 |
| 24 | | 268.6 | | | 255 | | | 6899.8 |
| 25 | | 200.6 | | | | | | 7100.4 |
| 26 | | 2.6 | | | | | | 7103.0 |
| 27 | | | | | | | | |
| 28 | | | | | | | | |
| 29 | | | | | | | | |
| 30 | | | | | | | | |
| 31 | | | | 480 | | | | 7583 |
| Total | 7,583 | 5,426 | 848 | 480 | 255 | 474* | 100 | 7583 |

*Includes 90 acres of fringing marsh

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## 8. FINANCING-COST ESTIMATIONS

### 8.1 Capital Costs

Capital investments for phosphate mining operations fall into two categories: 1) investment in reserves, and 2) investment in equipment and facilities, collectively termed plant investment.

Reserve Costs - Exploration and development costs include initial sample drilling, ore evaluation, processing feasibility studies, and economic evaluation of the property.

Land acquisition costs, on the basis of recent years' mineral property purchases in the area, range up to $1.00 per ton of phosphate rock produced over the life of the mine. Lands purchased in, and held since the 1960's are lower in purchase price, but the holding costs are significant. A range of $0.50 to $0.75 per ton of reserves is typical for these lands.

The cost of acquiring permits for initiating and operating phosphate mining developments in Florida has increased considerably in recent years. Reference is made to Page 113 of Reference 1, which outlines typical costs of environmental permitting efforts. Table 8.1-A summarizes reserves cost capital.

Table 8.1-A Reserved Cost Summary

| Reserves Acquisition | Capital Cost ($MM) |
|---|---|
| Exploration and development | $ 3.0 |
| Land acquisition (includes investment and taxes) | 30.0 |
| Permitting (includes supporting environmental studies) | 2.5 |
| Total | $35.5 |

Plant Investment Costs - Plant investment costs for similar production facilities range from $33.00 to $42.00 per annual ton of production, although wide variances are possible due to:

- Dragline costs (ore body depth)
- Concentration of Product in the ore
- Infrastructure costs
- Extent of wet rock storage and drying facilities
- Extent of support facilities

Table 8.1-B summarizes estimated capital cost data for the project based on facility cost submitted by Swift in their DRI, and distributed by area according to that of a typical mine of this size and ore characteristics.

Costs are on the increase due to a combination of 1) poorer ore quality and lower pebble content of ores which require heavier capital investment in larger, more expensive facilities,

Table 8.1-B Estimated Plant Investment

| Area | Total Estimated Cost | Cost Attributable to Environmental Constraints |
|---|---|---|
| Mine | $ 5,300,000 | $ 265,000 |
| Washer | 6,000,000 | ---- |
| Feed Preparation | 6,600,000 | ---- |
| Flotation | 7,300,000 | ---- |
| Water Distribution and Waste Disposal | 14,500,000 | 5,600,000 |
| Reagent Storage | 1,300,000 | 100,000 |
| Wet Rock Storage | 5,300,000 | ---- |
| Dryer, Dry Rock Storage, and Shipping | 8,600,000 | 1,200,000 |
| Offsites | 11,200,000 | 1,120,000 |
| Sub-Total | 66,100,000 | 9,285,000 |
| Fringes @ 30% of labor (est.) | 3,200,000 | 375,000 |
| Sales Tax @ 4% of material (est.) | 1,700,000 | 215,000 |
| Total Direct | 71,000,000 | 9,875,000 |
| Field Distribution @ 10% | 7,100,000 | 987,000 |
| Home Office (including engineering @ 11% | 7,900,000 | 1,090,000 |
| Sub-Total | 86,000,000 | 11,952,000 |
| Contingency @ 5% | 4,275,000 | 600,000 |
| Sub-Total | 90,275,000 | 12,552,000 |
| Dragline | 24,725,000 | ---- |
| Total | $115,000,000 | 12,552,000 |

and 2) environmental constraints which require additional capital investment in pollution control facilities to produce at a given rate.

Environmental Components' Cost - An estimate of the capital investment required to meet environmental requirements is to some extent arbitrary in that some practices required by law have been used in the industry for many years and accepted as standard procedure. Cost effects of environmental concerns by operational area are shown on Table 8.1-B. The principal items contributing to these capital costs are summarized below:

- Mine area -- additional pumping systems necessary for indirect routing to preserve areas of environmental concern.
- Water distribution and waste disposal -- enviroclear thickeners (special clay disposal technique), pumps and piping for water conservation; sand/clay mix tanks, ponds, reservoirs, ditches, pumps and piping for reclamation. Engineering and construction cost for dike compliance with state regulations.
- Reagent storage -- flocculent tanks, agitators, pumps and piping for enviroclear thickeners, perimeter dikes and drainage, alarm systems.
- Dryer, dry rock storage, shipping -- co-axial venturi scrubber, fan, sump, pumps and piping; silo scrubbers, fans, ducts, pumps, piping and recirculation pond; bag filters, fans and ducts.

- Offsites -- additional office space, heavy equipment, vehicles, tertiary sewage treatment, site preparation and drainage; all for support of environmental efforts in mine and process areas.

The total estimated capital represents about 11% of total facilities investment.

8.2 Operational Cost

Typical production costs for this size mine in the district were estimated in Reference 1, page 86. The report identifies the following key factors as affecting production costs:

- Ore concentration
- Concentrate to pebble ratio
- Matrix clay content
- Feed grade
- Total depth
- Contaminant content of ore
- Production rate
- Capital outlay

Operating costs vary widely due to these factors; however, these generalized estimates for mines of this type, size, and ore body characteristics provide a reasonable estimate for the Swift project.

Description of Cost Components - Production costs are composed of direct and indirect costs. Direct costs can be fixed costs or

variable costs. Fixed costs are those costs which do not vary with production, such as labor, supervision, overhead, supplies, mobile equipment, maintenance support and overhead. Variable costs generally include power, maintenance, reagents, and waste disposal. Indirect costs include insurance, taxes, interest on capital investment, working capital, home office expense, depreciation, royalties, severance taxes, etc. As with direct costs, some of these costs are fixed and some are variable.

Cost of Environmental Constraints - Cost effects of environmental constraints are often indirect and difficult to identify or accurately define. Assumptions used in arriving at the estimates are provided in Table 8.2-A.

Costs resulting from environmental constraints placed on suppliers of power, reagents, etc. are not included. These "pass along" environmental costs are beyond the scope of this study.

- Mine planning -- estimate two man-years are required for annual reviews and permit maintenance plus additional planning for mining sensitive areas. Includes overhead support costs such as secretaries, office expenses, vehicles, etc.
- Mine operation -- additional manpower, supervision, and overhead expenses for mine operation -- ($65,000);

Table 8.2-A Production Costs Attributed to Environmental Constraints (Basis = 3 million short tons per year)

| Area | (Annual) Estimated Cost | Cost/Ton |
|---|---|---|
| Mine planning | 120,000 | $ 0.04 |
| Mine operation | 125,000 | 0.04 |
| Waste disposal | 1,075,000 | 0.36 |
| Water management | 265,000 | 0.09 |
| Land Reclamation | 1,050,000 | 0.35 |
| Drying and shipping | 405,000 | 0.14 |
| Monitoring | 275,000 | 0.09 |
| Miscellaneous | 300,000 | 0.20 |
| Operational efficiency (downtime) | 250,000 | 0.08 |
| Depreciation | 717,000 | 0.24 |
| 10% Interest on: | | |
| a) Permitting costs ($2.5mm) | 131,000 | 0.04 |
| b) Extra Capital ($12.552mm) | 657,000 | 0.22 |
| Total | 5,370,000 | $ 1.79 |

increased power, maintenance, etc. for operation of water collection system -- ($60,000).

- Waste disposal -- higher cost of disposal other than by conventional methods, including clay slurry thickeners, power, reagents, supervision, maintenance of dams, etc.
- Water management -- personnel and supplies, power (pumping) from reservoir, recharge wells - installation and maintenance, and surveying.
- Land reclamation per presented plan.
- Drying and shipping -- increased power, maintenance, etc. for more efficient scrubbing equipment.
- Monitoring -- personnel, chemical analysis, reporting, overhead, etc.
- Miscellaneous -- public relations, counsel, technical consultants, R & D, mitigative action, etc.
- Operational efficiency loss -- downtime due to environmental equipment failure, lower equipment efficiencies, etc.

The total cost of $1.79 per ton of product ($5,370,000) is 9.8% of the typical, projected, operating cost.

Losses of reserves to wetlands, floodplains, and environmentally sensitive areas are not included in this estimate. Identification of these areas is not available. The cost associated with these reserve losses could range up to $0.18 per ton for properties abundant in wetlands.